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DEVELOPING AN INTERVENTION MODEL FOR PAYMENT FOR ECOSYSTEM SERVICES

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Abstract

Environmental degradation across the globe is accelerating due to the uncontrolled and unsustainable use of natural resources. Payment for ecosystem services models, proven to give additional value to society, are presented as means to address this problem. The present thesis is integrated into Maze's research to develop an intervention model to support environmental conservation and restoration efforts in Portugal. The main findings from this work are recommendations about the structure and key components of the model and suggests that payment for ecosystem services could be a suitable funding mechanism for improved forest management practices.

Key words: Intervention model, Payment for ecosystem services, Conservation and Restoration efforts, Improved forest management.

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1. Understanding the problem

1.1 Business Case For Action

Nature underpins all dimensions of human life. Balanced and healthy natural ecosystems are essential for our existence. Natural contributions range from providing air quality to ensuring fresh water or supporting food production through healthy soils. For example, marine and terrestrial ecosystems are the only sinks for anthropogenic carbon emissions. To give an idea of scale, each year, these natural ecosystems sequestrate about 5.6 gigatons of carbon, which is the equivalent to 60 percent of global emissions (IPBES, 2019). However, uncontrolled pressure on nature is putting at risk its future ability to support our societal needs. For instance, agriculture production has rocketed since the 1970 and the consequences are direct. Every year, between $235 Billion and $577 Billion in global crop outputs are at risks of being lost (IPBES, 2019). Such a conclusion is increasingly shared by the financial sector. Dutch financial institutions computed that up to €28 Billion (27 percent) of their agriculture, food processing and textile processing industries are directly at risk and dependent form pollination natural services (Van Toor, 2020). These synergies of population growth and expanding economic activity has increased the negative effect on the environment. As of 2019, 70 percent of the land surface is significantly altered, 66 percent of the ocean area is experiencing increasing cumulative impacts, and over 85 percent of wetlands (area) are lost (IPBES, 2019). This global trend, that favors extraction of marketable provisioning services (renewable and non-renewable consumable goods) at the expense of nonmarket natural services, has resulted in a rapid decline of wildlife and flora across all habitats (De Groot, 2013). This event is referred as the Sixth Extinction (Kolbert, 2014). Not only the biodiversity loss is pushing more than 1 Million species to extinctions, it is also undermining the resilience of our ecosystems (IPBES, 2019). A concrete and unfortunate example can be cited:

Covid - 19. Indeed, it has been established across the literature that the incidence of zoonotic diseases, such as coronavirus, is exacerbated by human activities (IPBES, 2019).

One of the key drivers is land use changes. Alongside the negative physical impact, the IPCC has determined that up to 23% of anthropogenic emissions of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) combined as CO2 equivalents between 2007 and 2016 are due to agriculture, forestry and other land use (IPCC, 2019). Past, present and future trends all point towards the direction of further degradation of the environment due to human activity, which also feeds another negative externality, climate change. This over-exploitation of natural resources is in part attributed to market failures where economic incentives have favored environmental harm over restoration and conservation's efforts. Contribution from ecosystem, which are public goods, are treated as externalities of production and not internalized in the value chain of producers (Clark, 2018). However, awareness about the scale and depth of the problem is increasing. A broader consensus about the primordial role of nature on the social, economic and environmental dimensions is emerging.

This common agreement is also arising from the private sector. More sophisticated approaches, moving away from conventional cost-benefit analyses, to account for natural benefits are used. Money spent on natural services is not simply seen as a cost anymore but rather as a worthwhile investment that brings multiple benefits (De Groot, 2013). Globally, it has been computed that ecosystem services are worth an estimate of $125-140 trillion per year, which represents more one and half-time the global GDP (OECD, 2019). Nevertheless, consequential economic value is being lost in natural services. Between 1997 and 2011, losses per year amounted to $4-20 trillion in land cover changes and $6-11 trillion from land degradation (OECD, 2019). Not only a strong biodiversity is crucial for building safeguards, such as food production and

disaster protection, it is also a central piece of the future sustainable development of our society. This notion of underlying support from natural capital to businesses is gaining traction among the private sector as nature contributions are directly linked to 35 of the 44 indicators of the Sustainable Development Goals (SDG) of the United Nations (IPBES, 2019) (OECD, 2019). Simply put, companies and institutions are realizing that the promised sustainable and resilient economies of tomorrow won't exist without protecting, restoring and improving the way we manage and use natural capital.

In that context, new solutions to support conservation and restoration efforts have emerged. It is called payment for ecosystem services. These models seek to find innovative and cost-effective solutions to complex issues linked to natures' contributions. So far, payment for ecosystem services programs have shown that they allow for better ecological, economic and social outcomes compared with "business as usual scenarios" and yield to a positive benefit to cost ratio (De Groot, 2013). Furthermore, these nature-based solutions can provide up to 37 percent of cost-effective CO2 climate change mitigation (under 2.0 °C) until 2030 (Griscom, 2017). Therefore, land-use actions are indispensable to reverse actual biodiversity trends to re-create a positive state by the mid-twenty-first century (Leclère, 2020) and the payment for ecosystem services model is emerging as a market tool to tackle part of the issue. Nevertheless, a major challenge on the road ahead needs to be overcome; catalyzing and directing funding into conservations and restoration efforts.

1.2 The Funding Gaps

Two major forces are converging towards ecosystems services solutions. On one side, a better scientific understanding about the role and importance of natures' contributions to our

society and on the other one, a more accurate estimation of its monetary value. However, computation and commitments are not translating into action.

In 2019, spending on biodiversity conservation was estimated between $124-143 Billion per year (Deutz, 2020). The total requirement to efficiently protect and restore nature capital is between $722-967 billion per year (Deutz, 2020). In order for nature-based solutions to reach their cost-effective climate mitigation potential by 2030 a yearly funding gap of about $598-824 Billion needs to be filled. Even though better valuation techniques to account for weight of nature contributions are used, cash flow and asset value of nature cannot still be measured with current economic tools (Deutz, 2020). Because there is no price on nature, and no costs associated, the unsustainable use of natural stocks continues, and the financing needs are not met.

Based on that conclusion, scaling up and aligning finance for biodiversity should be a priority and the private sector must be approached, as it constitutes one of the largest pools of available financing. Developing new models and instruments to capture funding to support the development of ecosystem services solutions are essential (IPBES, 2019) (Deutz, 2020) and the gargantuan complexity of the problem makes it a challenge to have common strategy and models. This need to create innovative and new forms of payment for ecosystem services models is a clear opportunity addressed in this work.

1.3 Literature Review On Payment For Ecosystem Services

The International Union for Conservation of Nature (IUCN) defines nature-based solutions as: “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits”. In other words, payment for ecosystem models seeks to internalize the positive externalities (third-party benefits) generated by natural systems (Salzman,

2018) and to serve as a tool to quantify these natural contributions. These models hold great promise in terms of improved environmental effectiveness, cost efficiency, and acceptance, when compared to traditional measures (Sattler, 2013). Indeed, building a model that recognizes costs and revenues of natural services to businesses can support the identification of synergies and requirements for trade-offs between the production of goods or services that create negative impact on nature (Keenan, 2019).

In our modern economies, the main types of payment for ecosystem services are watershed and carbon sequestration models. As of 2015, the watershed sector represented $24.7 billion in 62 countries (Salzman, 2018). However, this market is already mature and dominated by Governments (Salzman, 2018). On the other hand, the natural carbon sequestration sector still has untapped potential. Historically, the REDD mechanism (Reducing Emissions from Deforestation and Forest Degradation) has been the main tool used. This program supported by the EU since 2008 is active in 67 forests around the world. This scheme was created to support poorer countries to fight carbon emissions resulting from forest activities and pools together $8.1 Billion in commitments (Salzman, 2018). The means of action of the REDD are payments to forest owners. Through outcomes payments, land holders are incentivized to keep their surface areas untouched (Jayachandran, S., 2017). To function correctly, the size of payment must be competitive and integrated opportunity costs (Salzman, 2018). With that strategy, REDD has become the most economically efficient tool used in developing countries to reduce deforestation through the use of voluntary carbon credits (Pascual, 2014). However, the REDD suffers major drawbacks. The limited budget and the focus on cost efficiency impaired the development of other crucial aspects. The lack of monitoring, accounting for broader ecological functions and including social and local dimensions have hindered the potential impact of the model (Pascual, 2014). Moreover, issues of

insecure land tenure, elite capture of incentives, equity concern between recipients of payments and beneficiaries of ecosystem services, uncertainty over conditional based incentives, and unfavorable economics have mitigated further the impact (Clark, 2018). As a matter of fact, the REDD only paid out $218 Million in interventions until 2017 (Salzman, 2018), even though commitments represented more than $8.1 Billion. Unfortunately, this cost pressure trend is applicable to the larger scope of nature-based models. Even if land-based sequestration potential is proven, these solutions only receive about 2.5% of climate mitigation dollars (Griscom, 2017).

Another impediment to the large-scale development of nature-based solutions is the lack of common language and frameworks. The absence of shared principles, definition, evidence-based standards and guidelines on ecosystem services is common problematic identified across the literature (Cohen-Shacham, 2019). Because the payment for ecosystems services sector is not structured and poorly supported by public institutions, challenges of accounting for nature value and gathering evidence, through the use of globally standardized frameworks, has become a weakness (Keenan, 2019). As we have just seen with the REDD, Government implication does not necessarily translate into more financing. The "whole-government" approach leads to confusion inside the public body and with the private sector, where competition for funding with other areas such as education and health are fierce. The use of modern indicators, not adapted to the ecosystem services approach, justifies and redirect investments into these traditional areas based on cost-benefit analysis rather than on placements that have long-term positive implications and no short-term return (Keenan, 2019). The scientific literature on payment for ecosystem services models leaves us with an observation. Ambitious large-scale developments of conservations and restoration efforts are central to an effective post-2020 biodiversity strategy

(Leclère, 2020), but without more coordinated actions from governments as well as innovative approaches, all of this potential might just go to waste.

There comes the new entrant, that raises hope to accelerate the implementation of ecosystem services models, the private sector. The funding and innovation potential from businesses are underrepresented in the literature. The lack of actionable solutions to engage with the private sector has led to a waste financing and overall embodiment of payment for ecosystem services. If we consider that alongside avoiding deforestation, reforestation and improved land management practices represent the most effective carbon mitigation strategies for nature-based solutions (Griscom, 2017), then the private sector still has a major role to play. Coupled with the difficulty of valuing natural services and the high transaction costs (Jack, 2008), endorsement of nature-based solutions by private companies, even if indispensable, will prove to be a crucial challenge in the next decade. This innovative financing mechanism, based on collaborative partnerships, will represent an important shift in financial markets (Clark, 2018).

The analysis of the literature depicts both the high potential of nature-based solutions but at the same time, clearly shows that actual intervention models are not able to achieve the objectives required to mitigate global warming trends and support biodiversity regeneration. There lies the opportunity for an actor to structure the market, the financial intermediary. Intermediary involvement is related to the success of payment for ecosystem schemes. They function as a mediator to support transactions, standardization, monitoring, controlling and verifying ecosystem services delivery as well as reducing the overall costs of the scheme (Sattler, 2013). Finally, and it is the most important aspect, intermediaries motivated by conservation and restoration benefits help in creating trust among parties.

2. Methodology

The development of this work was integrated into the business research, established by Maze, of innovative ways to address environmental challenges in Portugal. The purpose of the thesis is to develop an intervention model for payment for ecosystem services and then to make recommendations about the next steps for its implementation in Portugal.

After having defined and understood the main problem as well as scanning the relevant literature, a profound comprehension of the structural elements of the model and other underlying problems must be acquired. Consultations were led to further gather knowledge about these crucial dimensions and each stakeholder. Maze met with Dr Peter Long, an environmental scientist at Oxford University and Allison Van Ketteler, Manager of the Ecosystem Services Program at the Forest Stewardship Council (FSC). Furthermore, one-on-one interviews were conducted with Bernardo da Silveira, Head of Capital Markets and Cristina Abreu, Directing Manager of the ESG Team at Banco Atlántico Europe. Christopher Daley, Program Officer of Forestry Space at Verra Standards was also contacted. Following these meetings, a first version of the model was designed.

To further adapt to the Portuguese context and develop a robust long-term-oriented intervention, an interview with Filipa Saldanha, Deputy Director of Sustainable development program at Gulbenkian Foundation, was conducted. In parallel, on text articles from online publications were used, and a thorough benchmark analysis was realized. Bringing together both dimensions, stakeholders' consultations and desk-based research, additional suggestions about the key elements of the model is made. These recommendations are the main outputs of this thesis and answer the following question: **What are the key components, and how should they be structured, of an intervention model to support and scale payment for ecosystem services in Portugal?**

3. Building an innovative Model

3.1 Carbon Credits Demand As A Growth Driver

Recent policy changes on LULUCF (amendment of the Land Use, Land Use Change and Forestry Regulation [EU] 2018/841) and their integration into the EU's 2030 Climate and Energy Policy Framework, is signalling the market that nature-based sequestration is a serious tool to mitigate climate change and offset emissions. However, because of risks undermining the environmental integrity of regulated carbon markets, LULUCF carbon credits cannot be exchanged on the European Emission Trading System (ETS). This non-integration is attributed to the uncertainties around the non-permanence of carbon storage, emissions reductions as well as the potential problems of emissions leakage. Furthermore, the quality of monitoring and reporting for nature-based solutions are not comparable to the monitoring and reporting of emissions from installations currently covered by the ETS. Therefore, only energy-intensive industries with stationary installations are accepted on the ETS (Appendix 1). In Europe it represented 10,744 permitted installations in 2018 (European Commission, COM/2019/577). For this reason, businesses willing to trade their emissions but do not have access to regulated carbon markets have to use another medium, the voluntary carbon market (VCM).

The increase in net zero commitments from the private sector is expected to grow the voluntary carbon market. In an emissions scenario consistent with a 1.5C, set up by the Paris Agreement, carbon markets could grow more than 15 times carbon credits per year in 2030, and over 100 times carbon credits per year by 2050 (TVCM, 2020). If we consider that, as of today, nature-based solutions represent the only scalable and viable solution to sequestrate carbon (McNeil, 2020), LULUCF demand is expected to fly through the roof. In that context, few critical issues arise. First, they are physical and technological limits to overcome to support such a growth.

Then, there is an already existing problem: a high supply of low-quality, low-trusted carbon credits. Because buyers are suspicious, since 2016, the gap between credit issuance and retirements have grown by 211 percent per annum (TVCM, 2020). This misalignment between issuance and retirements can be observed on the graph in Appendix 2. This trend is driving the prices down and creates a "trust problem". Already, we predict a shortage of quality verified carbon credits by 2025 (McNeil, 2020), even though the demand will grow tremendously. Building qualitative verified carbon credits, to create trust and confidence among stakeholders, is the center component of the intervention model developed in this work.

3.2 Stakeholders

The first vision for the payment for ecosystem services model includes three pillars: the Product, the Demand and the Supply. Within these pillars, five stakeholders' groups were identified and further scrutinized. The aim of the stakeholder's analysis is to frame the key dimensions of the model and how each actor fit into the pillars.

3.2.1 The Product

Carbon certification - Certification and verification of carbon credits are the core of the model. These credits allow ecosystem managers to generate additional revenue, scale new types of interventions and attract financing. For buyers, it is required to ensure framing, monitoring and certification, hence project quality. Regarding carbon certification, The Gold Standard and Verra Standards are the global actors. Both companies have respectively certified 1800 and 1676 projects. In the agriculture, forestry and other land use sector, Verra Standard is the leader with over 203,863,820 (Verra, 2020) credits issued. It is important to note that the REDD represent 81.9% (166,937,715) (Verra, 2020) of those verified carbon credits.

The first key point Mr. Daley underlined is the positive impact the pandemic has had on the sector. Surprisingly, the Covid event has increased the demand for carbon offsets and has required actors to innovate. In that context, the use of remote sensing, a tool to onboard, verify and monitor any area through the use of satellite technologies, has increased. This new instrument is expecting to decrease costs of certification for ecosystem managers and ease the access to carbon credits. Remote sensing opens the door to scaling new methodologies and payment for ecosystem models through faster, qualitative and more standardized carbon certification processes as well as raise hope of implementing small-scale projects.

The second essential information gathered is linked to verified carbon projects in Europe, as it is one of the regions with the lowest restoration commitments (Appendix 3). Three factors can explain this situation. First, there is already a carbon market supported by the ETS. Then, the low cost of REDD carbon credits has shifted the demand for offsets to developing countries (Forest Trends' Ecosystem Marketplace 2. 2020). Finally, there is an administrative challenge. In Europe, the forestry sector is accounted in the carbon balance of each Country. The issue of double accounting, which refers to selling or accounting twice for the same ton of carbon sequestrated, arise.

Two conclusions are reached here. First, carbon certification and new technologies will have to be combined to ensure the highest possible quality of carbon credits. Then, the competent public authorities in Portugal, i.e., Agência Portuguesa Do Ambiente (APA), will need to be contacted to mitigate administrative risks linked to double counting (6.2).

Monitoring - To further acquire knowledge about the remote sensing component, Maze met with Dr. Long, who developed a tool that generates spatially explicit information about land cover, biodiversity and ecosystem services. It can analyze land cover across Europe with a 30-

meter resolution including five different types of ecosystem services such as carbon sequestration, pollination, water, protection and recreation. NaturEtrade purpose is to monitor, verify and transform ecosystem services into commodities to be exchanged as financial assets. The tool reduces transaction costs (confirmed previously by Mr. Daley) and is identified as an innovation driver to enhance costs effectiveness and bridge financing gaps in the ecosystem services market (Clark, 2018). To build an innovative "Product", inclusiveness of remote sensing technologies, whether it is the NaturEtrade tool or other suppliers, is primordial.

3.2.2 The Demand

Corporate - Net zero commitments are one thing, the means to get there still represent the most difficult challenge (SBTI, 2020). As of today, the VCM is not considered by businesses as trustworthy market. This feeling is showcased by the oversupply of credits previously identified (3.1). Indeed, developing a clear, transparent and trustable buyer journey represents a major challenge for scaling the voluntary carbon market. This lack of transparency hinders the willingness of private companies to buy verified carbon credits. There are many concerns about the permanence of sequestrations under actual models, where long-term relationship with ecosystem managers is not enforced. Furthermore, the insufficient understanding of offsetting, negative publicity on associated projects, difficulty of finding sufficiently large project sizes, lack of quality of credits and lack of pricing transparency prevent the embodiment of nature-based solutions (TVCM, 2019).

We are left with the following conclusion. Even though there is a growing pressure from investors to change and commit to net zeros strategies, the nature-based pillar (SBTI, 2020), has not convinced businesses yet. This lack of trust was clearly identified during interviews with Banco Atlántico Europe. The overall lack of knowledge and mixed messages from the VCM are pushing

companies away from offsetting solutions. Businesses require certainty, stability and an end-to-end solution, which is not the case under the actual form of the voluntary carbon market.

The challenge to solve here is to create a transparent and clearly identifiable buyer journey. The flow of carbon credits from suppliers to buyers, and all the components linked to it, has to be faultless. Capturing net zero commitments into a structure that promotes transparency, quality, communication and trust on impacts realized is "the key success component" for the model.

3.2.3 The Supply

Forest Stewardship Council - The Forest Stewardship Council (FSC) is the largest and most reputable company in the world regarding forest certification. It has been a major actor in the market for more than 25 years and is considered as a reference, by the European Union, for developing sustainable forest management practices. The meeting with FSC confirmed Maze assumptions: there is a need and a space for intermediaries in the payment for ecosystem services market. Companies that structure, manage and monitor payment will play a decisive role to scale interventions. The relationships between private companies and land managers, seen now as mandatory to support restoration efforts, requires a "middleman" that organizes these exchanges.

Regarding the model itself, FSC plays a critical role when it comes to legitimacy and proof of impact. How? One of the key impediments regarding scaling payment for ecosystem models is the adequate control over the supply chain. It is a major drawback identified in the REDD. In that regard, both FSC forest management and ecosystem services certification ensure that reporting, monitoring and verification of "on the ground activities" are supervised. The most rigorous one is the forest management certification. Through ten principles (Appendix 4), it confirms that forests are managed in a way that preserves biological diversity, benefits of the lives of local people and workers, while ensuring it sustains economic viability (FSC International Standards, 2015). It is

only after receiving the forest management certification, that forest owners can be certified with the ecosystem services procedure. In both cases, an additional external actor, called verification and validation body (VVB), audits the forest every five years. To apply to the platform, forest managers will be required to have the forest management certification. Projects will also be required to have the ecosystem services procedures at the end of the intervention. These requirements will ensure the quality of carbon credits and a rigorous control over the supply chain.

FSC certified Ecosystem managers - There is another argument for why FSC certified forest managers are the relevant partners for Maze. First, in the long-term, sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks offer the largest sustained mitigation benefit (IPCC, 2019), and thus the highest risks mitigation for issuing carbon credits. It directly addresses the concern of permanence of carbon sinks from the private sector. Furthermore, large-scale intervention on ecosystems such as FSCs' is regarded as less expensive and require fewer upfront costs (De Groot, 2013). Then, there is a systemic issue specific to Portugal. The Agência Portuguesa do Ambiante (APA) has estimated that more than 20% of the total forest area has no owner, or its owner is unknown (National Forestry Accounting Plan Portugal 2021-2025, 2020). Moreover, only 3% of the forest land is owned by the State and other Public Administration agencies. Therefore, partnering with a private entity such as FSC that has defined areas is a logical choice, knowing that certified FSC forest in Portugal cover about 424 kha (4,240,000 m^2) (National Forestry Accounting Plan Portugal 2021-2025, 2020).

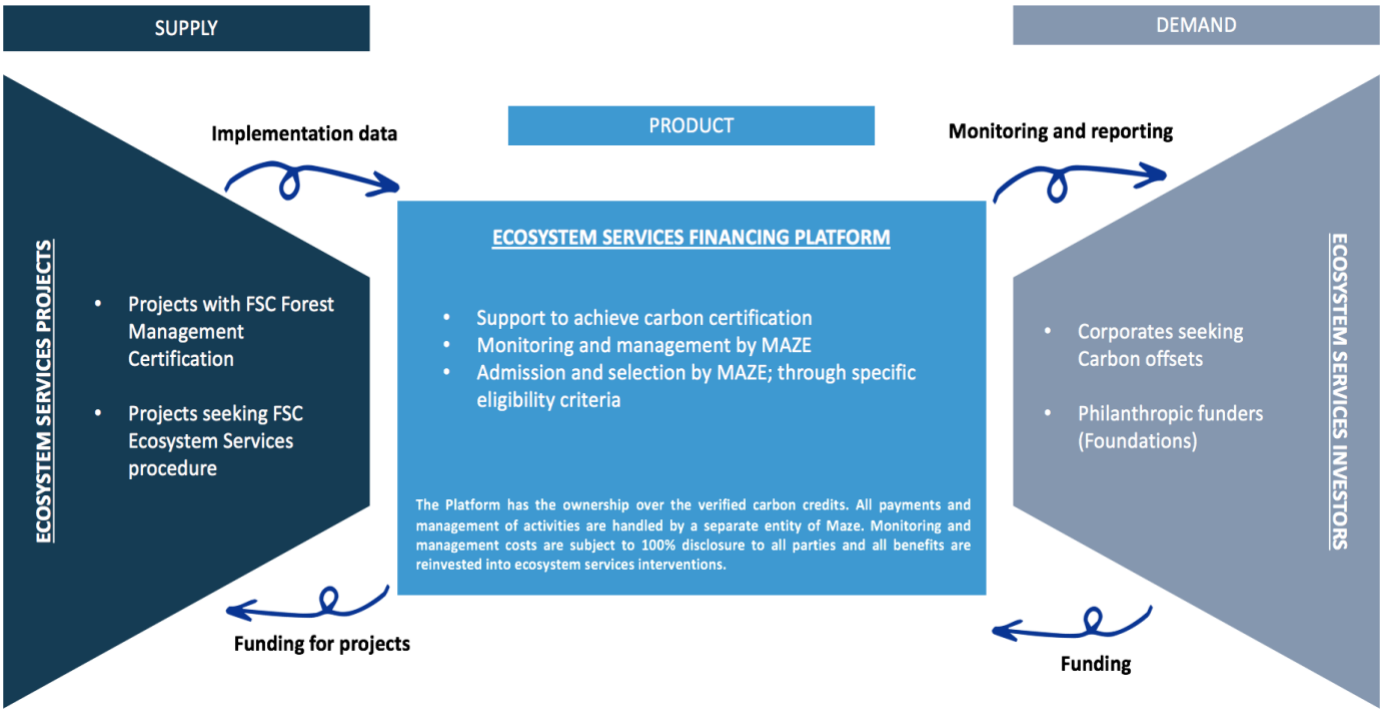
However, a challenge arises. What is the added value of our model if FSC certified forest already have all this proven impact? Indeed, the ecosystem services procedure was created to generate additional value through "ecosystem services claims" that certify the impact on biodiversity conservation, carbon sequestration, watershed services, soil conservation and

recreational services (FSC Guidance for Demonstrating Ecosystem Services Impacts, 2018). Since the introduction in August 2018, out of the 2 million hectares among FSC certified forest with the ecosystem services stamp, 1 million hectares are still looking for this "promised" added financial value. In itself, the tool is powerful to prove control over forestry activities and the impact, but it does not catalyze additional funding. Why? First, even with their best practices' certification, these forest owners lack financing and communication skills. Second, the certification only integrates ecosystem managers. Indeed, the procedure solely focuses on the Supply pillar whereas Maze's model brings together the three dimensions, Product, Demand, Supply, at same time and place. The model will be a tool for willing forest managers to promote their sustainable practices and to grow their activities. As an add-on, the integration of an advanced accounting and monitoring tool for carbon, which is non-existing in FSC certifications, will also lead to additional value creation for ecosystem managers.

3.3 A Payment for Ecosystem Services Model

With all the stakeholders' groups analyzed, a first draft of the model can be found below. Financing from businesses flows from the right to the left, through the "Product". Payments will only occur when the intervention by ecosystem managers is considered successful. In exchange, quality carbon credits, from FSC certified forest areas, are supplied to private companies. These credits will bear proven impact and strong carbon value and can be used as a marketing tool. Every exchange, whether from the Supply or the Demand side, are managed and structured through the "Product". Finally, carbon credits issued by ecosystem managers are owned by the platform, which

supports function of admission and selection of projects, carbon certification processes, monitoring and reporting.



4. Benchmark of interventions

So far, the model is designed on the comprehension of the market and the stakeholder's consultations. Additional comparisons against existing companies active in the sector are required. The details about the benchmark can be found in Appendix 5. The main highlights are the limits identified among actual payment for ecosystem services companies and the trends developing in the market. Two types of companies were scrutinized, financing platforms and consulting businesses.

Regarding financing platforms, there is a clear lack of the distinction between offsetting and reducing emissions as 3 out of the 10 companies benchmarked are promoting an "offset everything" mindset. Few platforms are developing projects and thus have little control over their value and supply chain. Indeed, half of the certified forestry projects offered are REDD, known to encounter these issues. Furthermore, the mistrust related to the buyer journey is identified as a

major issue in the market. 5 out of 10 of the financing platforms show a high risk of greenwashing with a low depth of impact business model. On the other side, consulting companies communicate better their impact and have greater control over projects. Only 1 out of 8 carry greenwashing risks. Nevertheless, scaling interventions is complex and is identified as a major drawback. The consulting approach is well adapted for large-scale interventions, but transaction costs are higher than financing platforms.

Looking at the trends now, we can observe that monitoring, valuation and mapping of forests are the main components that financing platforms use for their business model. In fact, financing platforms stand out from consulting companies by developing remote sensing technologies (3 out of the 10), token approaches via blockchain (2 out of 10) and accurate pricing methodologies directly integrated into the client's activities (API) (2 out of 10). Finally, another key trend is growing in the market. We found that 3 out of 8 consulting companies are developing their own methodologies for certifying carbon credits. Coupled with remote sensing technologies, it is opening the door to major innovations around certification and verification of carbon credits.

5. 2.0 model to scale interventions

For the private sector to "realistically" resort to nature-based sequestration, two things must happen. First the voluntary carbon market, which is highly fragmented (IPCC, 2019), needs to be regulated. Then a clear global strategy regarding nature-based offsets is required to ensure the quality and the rightful use of carbon credits from natural solutions. An assumption is made here, confirmed by market trends. Carbon removal from ecosystems needs to be scaled only after tremendous reduction efforts are undertaken (SBTI, 2020), and large-scale implementation should happen in the medium to long term (TCVM, 2020). Based on this information, the preliminary

model and the benchmark analysis, additional recommendations about the structure and the components of the model are made.

5.1 Recommendations

5.1.1 Carbon Certification Business Model

The first recommendation is for the model to become a carbon certification platform. Recent technological changes, including satellite imaging, digital sensors, and distributed-ledger technologies (DLT), coupled with accredited validation and verification bodies (VVBs) will ensure speed, accuracy and integrity of processes for carbon certification as well as the validation of methodologies to authorize issuance of carbon credits. As we saw, such models are appearing in the market and can generate the same quality credits as the one from Verra and The Gold Standard (claim supported by Mr. Daley). Directly certifying offsets will be a major competitive advantage to convince supply and demand sides to partner with Maze. This structure will also reduce transaction costs as revenues will be generated on certification, leaving all carbon credits issued to ecosystem managers.

5.1.2 Transparency on Offsets

Concrete action must be taken to reduce the high risk of greenwashing related to nature-based offsetting. Emphasis on transparency is required to promote trust, quality and effectively deal with the stakeholders and the risks. The recommendation here is to only accept companies looking to become carbon negative. Hence, businesses that already have in place strategies to reduce their emissions and plan to become CO2 negative in the long run. This action would position Maze as a trustworthy partner solely focused on restoration and conservation efforts.

5.1.3 Outcome Based Payments

Another recommendation is linked to the nature of payments happening under a verified carbon credit regime. Outcomes based model for payment for ecosystem services are regarded as the contractual structure ensuring the most success in a voluntary context (Sattler, 2013). Outcomes payments should be linked to three metrics: delivery of FSC ecosystem services certification (1), issuance of carbon credits (2) and proof of additionality (3), which refers to measurable and verifiable outcomes that go beyond what would have happened in the absence of the intervention.

There is, however, a challenge related to the implementation of outcome-based schemes: payment of initial costs to start the program. One way of addressing this issue is through the support of an investor, here a philanthropic foundation (as seen in the model [3.3]). In theory, the Foundation would bear the initial costs of the intervention to then be reimbursed by the Government once the outcomes are reached. With that in mind, it is recommended to seek a potential partnership under the Gulbenkian Sustainable Program. This program aims to set up an ecosystem services project in Portugal, where the Government would pay the initial costs if the intervention is successful. The time horizon required by this program is a maximum of 3 years, which would give time to generate benefits and leave the project running when the program closes.

5.1.4 Legal Structure and Contracting

It is recommended to set up a non-profit distinct from Maze to ensure the success. The NGO approach reduces transaction costs and builds trust. Indeed, the focus on conservation efforts through the reinvestment of profits generated in ecosystem services projects send a strong signal to the market. Furthermore, in the Portuguese context, private companies can deduct 120% of the

taxable amount on their EBITDA when they support an environmental NGO (Estatuto dos Benefícios Fiscais Decreto-Lei n.º 215/89).

Finally, 5-year contracts are recommended with ecosystem managers. It will support the long-term vision of interventions and is aligned with the time horizon of verification and validation bodies for FSC certified forest (FSC International Standards, 2015). As companies require more flexibility, it is advised to set short-term contracts renewable each year.

5.2 Maze Pilot

Implementing a Pilot lasting a minimum of 5 years is recommended to ensure the operational integrity of the model and build trust among stakeholders in the Portuguese market (Appendix 6). Furthermore, even if the platform runs under a non-profit structure, a coherent revenue model is required. To design a first version, the business models of Verra and The Gold standard are applied to the Maze Pilot (Appendix 7). The goal, here, is to extract learning and understand the next steps for implementation. Additional elements regarding the intervention of ecosystem managers are taken into account.

5.2.1 Additional Elements

For conservation and restorations of biodiversity activities, a minimum success rate of 75% is assumed (De Groot, 2013). It means that at least 75% of carbon credits will be issued. Likewise, 20% of the issued credits will be placed in a pool as a safeguard measure (carbon practices). We also have to assume a sequestration potential for a given natural area. A eucalyptus forest is considered here because it represents the most abundant type of managed plantation forests in mainland Portugal (National Forestry Accounting Plan Portugal 2021-2025. 2020). In these types of forest, ecosystem managers can expect to sequestrate on average 10 tons of CO2 per hectare per year (Myers, 1991).

5.2.2 Results and Observations

Three scenarios, based on a 1000 hectare, were run: 55%, 65% and 75% success rate (includes the 20% deduction). The carbon price per ton assumed is €24.84 (ICAP, 2020). For the first year, Maze revenues are for scenario 1: €4,577, Scenario 2: €4,603 and Scenario 3: €4,649 (Appendix 7). The numbers are the average of both Verra and The Gold Standard's business models (Scenario 1 = [7665+1461]/2). For subsequent years, revenues fall to €359, €397 and €435 across the three scenarios. Ecosystem managers generate, in the first year, €129,557, €154,351 and €179,176 (Appendix 8). The subsequent years, certification costs decrease, and the cash flows generated is €133,761, €158,563 and €183,388.

We can observe a first issue related to the carbon certification revenue model. Cash flows are based on fixed fees linked to the implementation of projects, and variable fees on the number of credits issued. Fixed fees are high, and variables are low. This is why in the second-year revenues fall. Indeed, these carbon certification models are not impacted by the carbon credit price per ton and nothing is deducted on the number of credits bought by businesses. If we assume that the platform generates additional benefits for Demand and Supply stakeholders, inclusiveness of these two additional revenue streams with a reduction of fixed fee for an increase in variable fees is expected to generate a more balanced revenue model.

We reach another important conclusion for both the carbon certification revenue model and the cash flows generated by ecosystem managers: the carbon credit price is based on the ETS and will be higher for nature-based projects. Carbon credits are composed of two dimensions, the price of a ton sequestrated and the value of additional benefits (Appendix 9). If the carbon price per ton is fixed by the market (ETS), additionality value can be negotiated. For the model to generate

further benefits to ecosystem managers and balance revenues for the platform, a focus on additionality maximization is crucial.

6. Limitations

6.1 Costs integration

For ecosystem manager, opportunity costs and implementation costs are unknown. The costs taken into account are related to the carbon certification and the yearly validation and verification body (VBB). Because FSC certified forest managers are targeted, maintenance costs are expected to be low. Additional research must be conducted to understand the monetary value of the managed forests areas and the monetary benefits of the intervention model.

For the Pilot revenue model, the budget required to manage the financing platform and integrate the monitoring is unknown. Furthermore, as a carbon certification company, consultants to support the implementation of the right intervention methodology will have to be contracted to ensure quality credits. These additional costs are not integrated into the modelization, which stresses the fact that carbon prices must increase through the focus on additionality benefits.

6.2 Double Accounting

The issue of double accounting, which is counting twice for the same ton of CO2 sequestrated, is the biggest limitation. Why? Because LULUCFs are accounted in Countries that ratified The Kyoto Protocol, hence Portugal. Indeed, The Kyoto Protocol defines under article 3, paragraphs 3 and 4 the accounting of emissions and removal from LULUCFs (UNFCCC, 2008). The categories are afforestation and reforestation, deforestation, forest management, cropland management, grazing land management and revegetation. It means that Portugal is taking into account the carbon balance (emissions - sequestration) of these different groups. Because the intervention developed in this work directly falls under the category “Forest Management”, the

risk of double accounting for the same ton of CO2 sequestrated arises. Under this situation, one ton of CO2 is sold through Maze's Pilot and one ton of CO2 is sold by Portugal through European assigned amount units (AAU), whereas only one ton of CO2 was sequestrated. In that context, issuing verified carbon credits such as Verra and The Gold Standards for nature-based projects are not permitted. Only one exception can occur.

The country, here Portugal, has to cancel an amount of AAU equivalent to the number of verified credits issued by the project. Proof of this cancellation must happen prior to the launch of the project and checked every year. Contacting Portuguese authorities to verify if a cancellation is possible is the priority moving forward. The integration of relevant public authorities to ensure the success of the intervention is thus mandatory.

7. Further Research

The orientation of future research will depend on the double accounting issue. If public authorities accept the cancellation of a defined amount of AAU, then for the purpose of developing and implementing the intervention model in Portugal, a feasibility analysis must be conducted. More research about the costs structure of FSC forest managers as well as the platform must be carried. In that case, it is envisioned to launch a Pilot in the year 2021 (Appendix 6).

On the other hand, if the cancellation is not possible, a new approach for the business model should be developed: biodiversity/resilience credits. Indeed, rebuilding resilient ecosystems in Portugal is crucial. The country has planned to reforest about 8,000 hectares per year until 2050 (Roadmap for carbon neutrality 2050, 2019). The verified carbon credits approach should not be considered there. Nevertheless, the model designed in this work defines the elements needed to support these types of interventions that require cross-sectorial collaboration. Biodiversity credits, as a tool to finance and rebuild resilient ecosystems, is identified as a topic for further research.

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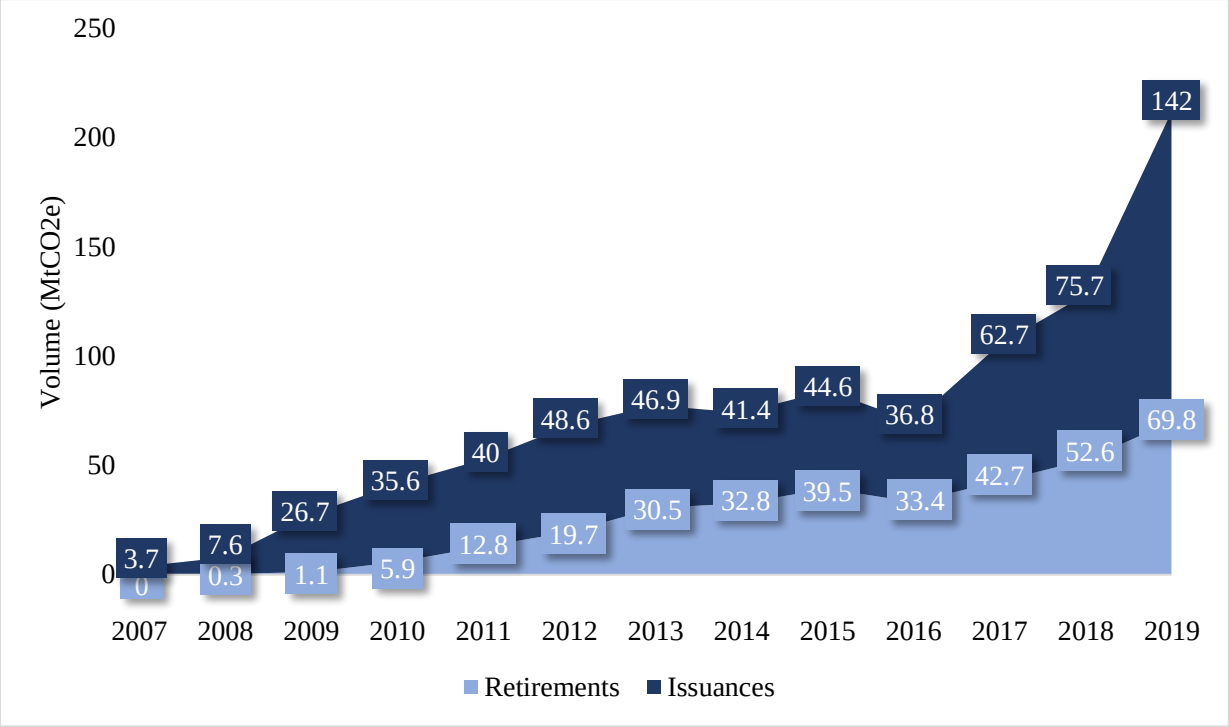
9. Appendixes

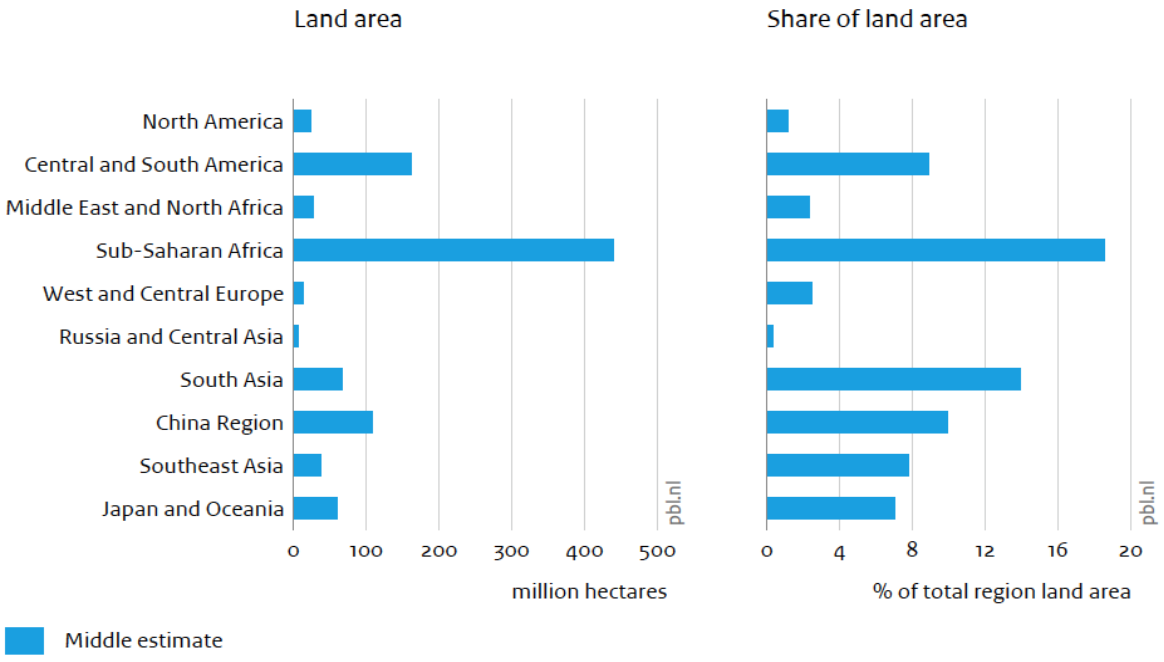
Appendix 1: Sectors included in Phase 3 ETS (2013-2020) (European Commission, COM/2019/577)

Sectors included in Phase 3 ETS (2013-2020)
Power stations and other combustion plants with >20MW thermal rated input (except hazardous or municipal waste installations)
Oil Refineries
Coke Ovens
Iron And Steel
Cement Clinker
Glass
Lime
Bricks
Ceramics
Pulp
Paper And Board
Aluminum
Petrochemicals
Ammonia
Nitric
Adipic
Glyoxal And Glyoxylic Acid Production
Co2 Capture
Transport In Pipelines And Geological Storage Of Co2.

Appendix 2: Annual Voluntary Carbon Offset Issuances and Retirements, 2007 – 2019 (Forest Trends' Ecosystem Marketplace 1, 2020)



Appendix 3: Total restoration commitments per region (Sewell, 2020)



Appendix 4: FSC Principles And Criteria For Forest Stewardship (Forest Stewardship Council, 2015)

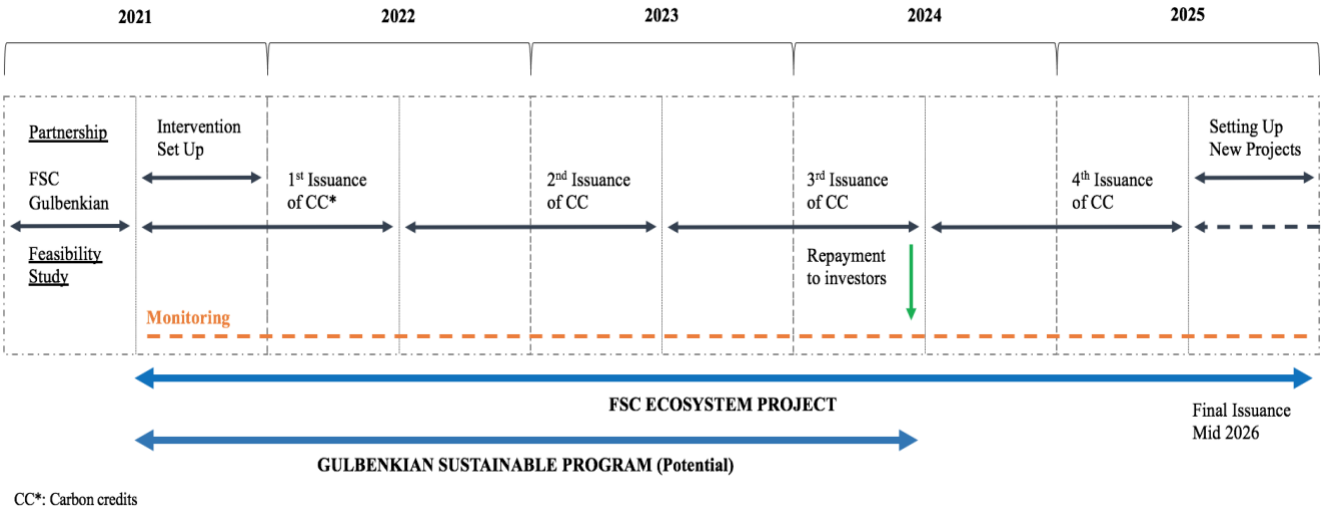
Principle 1: Compliance with Laws
Principle 2: Workers' Rights and Employment Conditions
Principle 3: Indigenous Peoples' Rights
Principle 4: Community Relations
Principle 5: Benefits from the Forest
Principle 6: Environmental Values and Impacts
Principle 7: Management Planning
Principle 8: Monitoring and Assessment
Principle 9: High Conservation Values
Principle 10: Implementation of Management Activities

Appendix 5: Key data Benchmark analysis

Key data Benchmark analysis		
Companies	24	
Financing platforms	10	
Consulting Companies	8	
Other land use companies	3	
Number of forestry projects	282	
Projects in Portugal	3	
Land life company	1	No use of verified carbon credits
ReforestAction	2	

Name of companies benchmarked		
Financing Platform	**Consulting companies**	**Other land uses**
Core Carbon	The Gold Standard	Indigo Carbon
Pachama	PlanA.Earth	DroneSeed
Hellocarbo	WeForest	Soil Capital
Overstory.ai	TerraCarbon	
Tapio	ClimateCare	
Regen Network	Land Life company	
Reforest´Action	Katingan Mentaya	
Cloverly	Soil Value Exchange	
Ecotree Green		
Nori Carbon Marketplace		

Appendix 6: Timeline of intervention for Maze's Pilot



Appendix 7: Revenue model, Carbon certification Platform

The Gold Standard		
Variable Costs		
First year Credit Issuance	€ 0,30	Number of Credits*Price
Subsequent issuance	€ 0,30	Number of Credits*Price

	Year 1			
		Scenario 1	**Scenario 2**	**Scenario 3**
	(Success Rate)	75%	85%	95%
	Credits issued	550	650	750
Fixed Costs	Account opening fee	€ 1.000,00	€ 1.000,00	€ 1.000,00
	Preliminary Review Fee	€ 3.500,00	€ 3.500,00	€ 3.500,00
	Project Design Review	€ 1.500,00	€ 1.500,00	€ 1.500,00
	Performance Review	€ 1.500,00	€ 1.500,00	€ 1.500,00
Variable costs	First year Credit Issuance	€ 165,00	€ 195,00	€ 225,00
	Total	**€ 7.665,00**	**€ 7.695,00**	**€ 7.725,00**

Subsequent years			
Subsequent issuances	€ 165,00	€ 195,00	€ 225,00
Total	**€ 165,00**	**€ 195,00**	**€ 225,00**

Verra Standard	
Variable Costs	
Issuance Fee	[(Estimated issuance – Buffer) x €0.16]
Activation/cancellation (Forestry projects)	[(Total issuance – Buffer) x €0.16] + [Buffer x €0.04] – [Issuance fee]
Transfer (per unit)	€ 0,30

	Year 1			
		Scenario 1	Scenario 2	Scenario 3
	(Success Rate)	55%	65%	75%
	Credits issued	550	650	650
Fixed cost	Account opening/set up (one-time)	€ 300,00	€ 300,00	€ 300,00
	Account maintenance (annual)	€ 300,00	€ 300,00	€ 300,00
	Project listing submission (per project)	€ 500,00	€ 500,00	€ 500,00
Variable Costs	Issuance Fee	€ 88,00	€ 104,00	€ 104,00
	Activation/cancellation (Forestry projects)	€ 96,00	€ 112,00	€ 112,00
	Transfer (per unit)	€ 165,00	€ 195,00	€ 195,00
	Total	**€ 1.449,00**	**€ 1.511,00**	**€ 1.511,00**

Subsequent years			
Account maintenance (annual)	€ 300,00	€ 300,00	€ 300,00
Issuance Fee	€ 88,00	€ 104,00	€ 104,00
Transfer (per unit)	€ 165,00	€ 195,00	€ 195,00

Total	**€ 553,00**	**€ 599,00**	**€ 599,00**

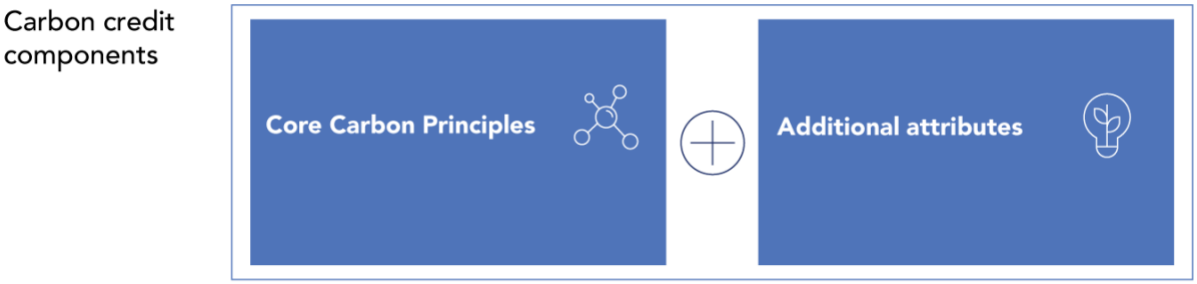
Appendix 8: Revenue model, FSC ecosystem manager

Information	
Carbon credits per hectare per year (Tons)	10
Area (Hectare)	100
Credits Issued	1000
Verification and Validation Body	€ 2500
Price per credits / Ton	€ 24,84

Year 1			
Scenario	Scenario 1	Scenario 2	Scenario 3
Success rate	75%	85%	95%
Carbon Buffer (20 pp)	55%	65%	75%
Credits issued	550	650	750
Revenues	€ 136,620.00	€ 161.460,00	€ 186.300,00
Cost carbon certification	€ 4.563,00	€ 4.609,00	€ 4.624,00
VVB	€ 2.500,00	€ 2.500,00	€ 2.500,00
Total	**€ 129.557,00**	**€ 154.351,00**	**€ 179.176,00**

Subsequent years			
Scenario	Scenario 1	Scenario 2	Scenario 3
Success rate	75%	85%	95%
Carbon Buffer (20 pp)	55%	65%	75%
Credits issued	550	650	750
Revenues	€ 136,620.00	€ 161.460,00	€ 186.300,00
Cost carbon certification	€ 359,00	€ 397,00	€ 412,00
VVB	€ 2.500,00	€ 2.500,00	€ 2.500,00
Total	**€ 133.761,00**	**€ 158.563,00**	**€ 183.388,00**

Appendix 9: Definition of core carbon principles and additional attributes (TVCM, 2020)



Description	A ton of verified carbon or carbon equivalent removed, avoided, or reduced Adhering to a set of threshold quality criteria for the credit and the supporting standard / methodology	Other product attributes described in a taxonomy (e.g., project type, co-benefits, region, location, vintage) that buyers find helpful in addition to the "pure" carbon